ISSN 1809-127X (online edition)
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LISTS OF SPECIES

Fish, Mogi Guaçu reservoir and four oxbow lakes, state of São Paulo, Brazil

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ABSTRACT: The Mogi Guaçu River is one of the largest rivers in state of São Paulo, belonging to Paraná hydrographic system. A study about fish composition in the Mogi Guaçu reservoir and four oxbow lakes downstream the reservoir is showed. A total of 2,367 individuals from six orders, 17 families, and 46 species were collected during August 2005 to July 2006, using gillnets, traps and hand nets. In the reservoir were found 31 species and in the oxbow lakes 24, in which Curimatidae and Characidae were the most abundant families, respectively.

INTRODUCTION

The Mogi Guaçu River is located at upper Paraná River basin which includes the largest rivers in state of São Paulo and a great fish fauna diversity with 38 families, 310 species (236 are autochthonous) and 50 new species under description (Langeani *et al.* 2007). This basin has been strongly impacted by human activities, such as deforestation and hydroelectric dams that caused many negative impacts to the fish fauna (Castro and Menezes 1998). Nevertheless, these constructions are very common in Brazil (Agostinho *et al.* 2007).

The Mogi Guaçu River basin has a fish fauna that has been better studied in relation to other drainages in Brazil (Meschiatti and Arcifa 2009). The first studies started with species lists and descriptions (Ihering 1929; 1930; Campos 1945a; b; Travassos 1955; 1956; 1960; Gomes 1956; Travassos and Pinto 1957; Gomes and Schubart 1958; Schubart and Gomes 1959; Britski 1964; Schubart 1964; Godoy 1975), and biology of large-sized species from the river channel (Godoy 1954; 1967; Nomura *et al.* 1972; Nomura 1975; Nomura and Taveira 1979; Toledo *et al.* 1987; Esteves and Pinto-Lôbo 2001; Capeleti and Petrere Jr. 2006). The Mogi Guaçu River has an extensive floodplain with more than 90 oxbow lakes (Vieira and Verani 2000), where many authors studied the fish fauna in different aspects (Galetti Jr. *et al.* 1990; Meschiatti 1995; Esteves and Galetti Jr. 1994; 1995; Esteves 1996; Esteves *et al.* 2000; Ferreira et al 2000a; b; Meschiatti *et al.* 2000a; b; Vieira and Verani 2000; Esteves 2000). Recently, small-sized stream species, poorly studied and without commercial interest, have received more attention from researchers in this basin (Oliveira and Garavello 2003; Birindelli and Garavello 2005; Ferreira 2007; Perez Jr. and Garavello 2007; Apone *et al.* 2008; Oliveira *et al.* 2009).

Herein, we present a checklist of the fish fauna from Mogi Guaçu reservoir and four oxbow lakes from Ecological Station (Campininha farm) of the upper Mogi Guaçu River basin in the state of São Paulo, Brazil.

MATERIAL AND METHODS

Study site

The Mogi Guaçu River rise in the Mantiqueira mountain range at 1,650 m, in the state of Minas Gerais, Brazil. The Mogi Guaçu reservoir (22°21' S, 46°51' W), located in municipality of Mogi Guaçu (state of São Paulo) was formed in 1995 by the damming of the river (Figure 1). Some reservoir characteristics are: surface area of 5.73 km^2 with an impounded capacity of 32.89 million m^3, dam with 150 m long, water fall with 7 m, two installed turbines, four flood gates (Brandimarte *et al.* 2008), and a fish ladder with 21 step-tanks for fish passage.

The Mogi Guaçu Ecological Station, also known as Campininha farm (22°16' S, 47°12' W), is a permanent preservation area that comprises 980.71 ha located at Martinho Prado Jr. on Mogi Guaçu district (Figure 1). There are small permanent oxbow lakes with seasonal connection with the river during the flood pulse (summer). The four oxbow lakes studied (Catingueiro, Barrinha, Pedra and Fundão) are located near the right Mogi Guaçu River margin and 43 km far from Mogi Guaçu reservoir.

Data collection

A total of six samples were taken in Mogi Guaçu reservoir (August, October and December 2005, February, April and June 2006) and oxbow lakes (August and December 2005, January, March, June and July 2006) using gillnets (mesh sizes from 1.5 to 5.0 cm knot to knot), traps, and hand nets. The sampling effort was standardized to a constant time (gillnets and traps were set in the afternoon and removed in the morning of the following day and hand nets were used 10 times on macrophyte banks) at each sampled point.

In the laboratory, fishes were fixed in 10 % formalin and kept in 70 % alcohol solution. Specialists were consulted to identify the fish species. Voucher specimens are deposited in the fish collection of the Zoology Department (UNESP - Rio Claro/SP). Collects were authorized by IBAMA

(02027.000991/2005-71) and COTEC (42.042/2005). The taxonomic placement of the collected species was defined according to Buckup *et al.* (2007).

RESULTS AND DISCUSSION

A total of 2,376 individuals belonging to six orders, 17 families and 46 species were collected (Table 1, Appendix 1). The fish fauna composition showed the taxonomic predominance of the orders Characiformes (86.4 %) and Siluriformes (7.7 %) and the presence of Cyprinodontiformes (3.8 %), Gymnotiformes (1.6 %), Perciformes (0.4 %) and Synbranchiformes (0.1 %), in accordance with the expected for the Neotropical region (Lowe-McConnell 1999). These results are similar to other studies carried out in Mogi Guaçu River basin (Galetti Jr. *et al.* 1990; Meschiatti 1995; Meschiatti *et al.* 2000a; Oliveira and Garavello 2003; Ferreira 2007; Perez Jr. and Garavello 2007; Apone *et al.* 2008; Oliveira *et al.* 2009).

A total of 31 species were collected in reservoir and 24 in oxbow lakes (Table 1). Characidae and Curimatidae were the most abundant families in both areas which indicate the dominance of a few species: *Cyphocharax modestus* (Curimatidae) present in 25.5 % of the samples, followed by *Hyphessobrycon eques* (Characidae) with 16.0 %, *Steindachnerina insculpta* (Curimatidae) with 7.2 % and *H. bifasciatus* (Characidae) with 4.7 %.

Schubart (1962) presented a list with 97 species to the Mogi Guaçu River and, in a further study Godoy (1975) listed 100 species. Recently, Meschiatti and Arcifa (2009) synthesized 150 species distributed in this same River basin. Castro and Menezes (1998) registered 166 species occurring in the upper Paraná River basin and more recently, Langeani *et al.* (2007) summarized 310 species in the same region. In the present study 46 species were caught, which represents 31 % of those reported by Meschiatti and Arcifa (2009) and 15 % of those reported by Langeani *et al.* (2007). This richness is, in part, in due to the oxbow lakes. According to Galetti Jr. *et al.* (1990), Esteves *et al.* (2000) and Meschiatti *et al.* (2000a) these environments are explored by small-sized species and constitute naturals refuges to large-sized juveniles species. Esteves *et al.* (2000) found eight species collected in two oxbow lakes, Catingueiro and Barrinha, from Mogi Guaçu Ecological Station, contrasting with 24 species registered in the present study. This difference may have resulted from the inclusion of two additional oxbow lakes, Pedra and Fundão, in the samplings and a higher sampling effort.

The fish fauna found in the Mogi Guaçu reservoir and Ecological Station oxbow lakes was composed by typical species from high Paraná River basin which indicates a condition that encompasses native species mostly (except *Hoplerythrinus unitaeniatus*, *Metynnis maculatus* and *Piaractus mesopotamicus*) (Langeani *et al.* 2007). In the past, small introductions were common in some Campininha's farm lakes (personal observation). According to Meschiatti and Arcifa (2009), several introductions of allochthonous and exotic fish species have occurred in Mogi Guaçu River basin since 1959. Only one specimen of *Piaractus mesopotamicus* was captured during this study. The presence of this species in reservoir is probably due to introduction by fishermen, or by escaping from fishponds used for sport fishing (Meschiatti and Arcifa 2009). Hundreds of fishponds are located in the Mogi Guaçu basin, which represents a potential source for introduction of exotic species into natural water bodies (Fernandes *et al.* 2003).

This study also registered three new species to this basin: *Metynnis maculatus* was found in Catingueiro and Barrinha lakes, *Pseudopimelodus pulcher*, and *Imparfinis borodini* were captured in the Mogi Guaçu River downstream reservoir. These species were not reported in a recently study conducted by Meschiatti and Arcifa (2009) in the Mogi Guaçu River basin.

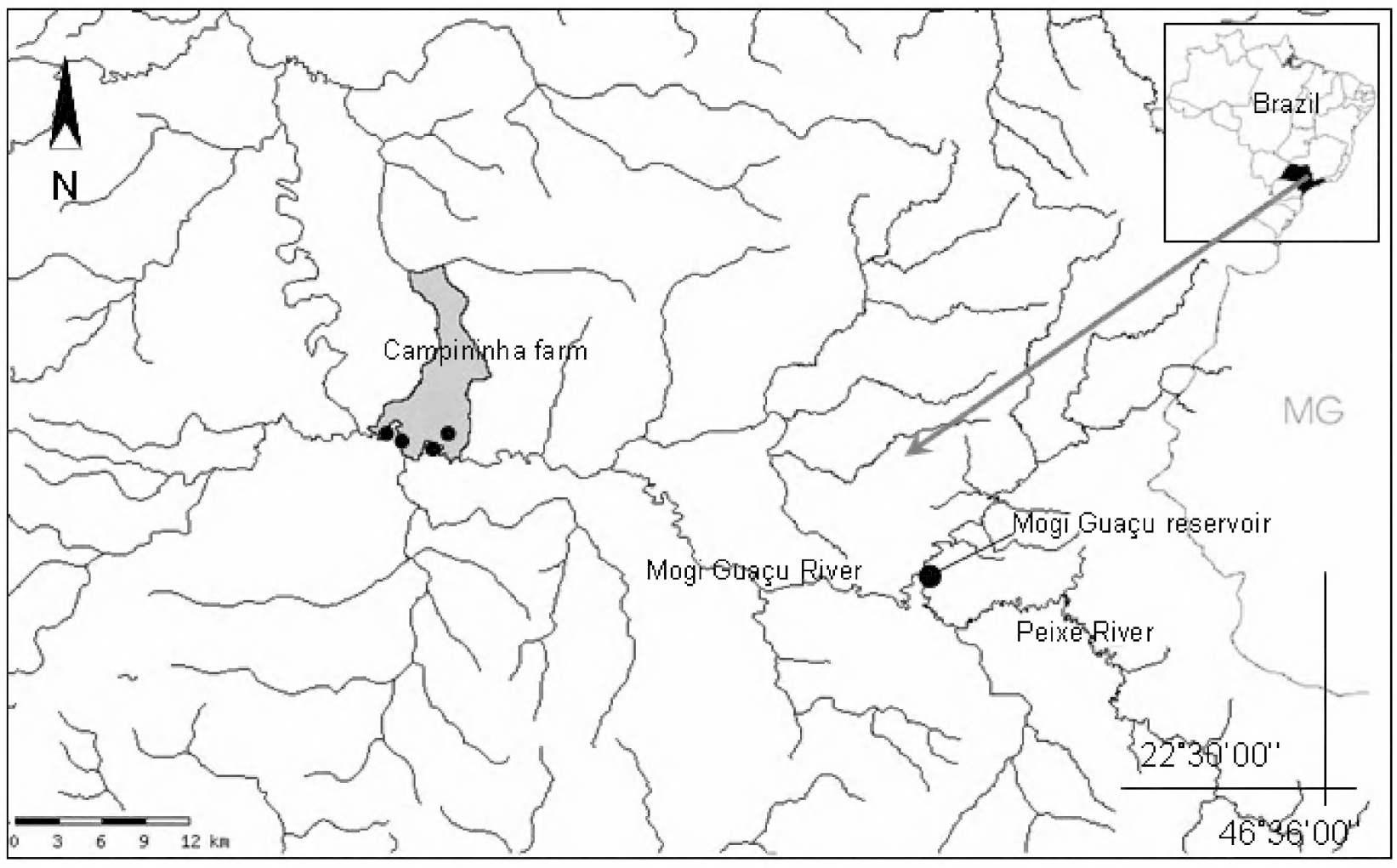

Figure 1. Map of the state of São Paulo showing the the sample sites (black dots) in the study areas: Mogi Guaçu reservoir and Ecological Station (Campininha farm) oxbow lakes. Map modified from CRIA (Centro de Referência em Informação Ambiental; Electronic Database accessible at http://www.cria.org.br. Captured on 02 November 2007).

Table 1. Fish fauna from the area influenced by Mogi Guaçu reservoir and Mogi Guaçu Ecological Station (Campininha farm) oxbow lakes. (1) Mogi Guaçu reservoir; (2) Catingueiro lake; (3) Barrinha lake; (4) Pedra lake; (5) Fundão lake. Regional popular names of each species are provided between quotation marks. Species captured on Mogi Guaçu River, downstream reservoir, are marked with *. Taxonomic classification followed Buckup *et al.* (2007).

ACTINOPTERYGII

CHARACIFORMES

Curimatidae

Cyphocharax modestus (Fernández-Yépez, 1948) – "sagüiru" [1, 3, 5]

Cyphocharax cf. *nagelii* (Steindachner, 1881) – "sagüiru-branco" [1, 5]

Steindachnerina insculpta (Fernández-Yépez, 1948) – "sagüiru" [1,5]

Prochilodontidae

Prochilodus lineatus (Valenciennes, 1836) – "curimbatá" [1, 4, 5]

Prochilodus vimboides Kner, 1859 – "curimbatá" [1, 4, 5]

Anostomidae

Leporinus lacustris Campos, 1945 – "piau-da-lagoa" [3]

* *Leporinus obtusidens* Valenciennes, 1836 – "piapara"

Leporinus octofasciatus Steindachner, 1915 – "ferreirinha" [1]

Schizodon nasutus Kner, 1858 – "taguara" [1]

Characidae

Cheirodontinae

Odontostilbe sp. – "pequira" [1]

Serrapinnus heterodon (Eigenmann, 1915) – "pequira" [1]

Serrapinnus notomelas (Eigenmann, 1915) – "pequira" [3, 4, 5]

Serrasalminae

Metynnis maculatus (Kner, 1858) – "pacu-prata" [2, 3]

Piaractus mesopotamicus (Holmberg, 1887) – "pacu" [1]

Serrasalmus maculatus Kner, 1858 – "piranha" [1, 3, 5]

Incertae sedis

Astyanax altiparanae Garutti & Britski, 2000 – "tambiú" [1, 3, 4, 5]

Astyanax fasciatus (Cuvier, 1819) – "lambari-de-rabo-vermelho" [1, 4, 5]

Astyanax schubarti Britski, 1964 – "lambari" [1]

* *Bryconamericus stramineus* Eigenmann, 1908 – "piaba"

Hyphessobrycon anisitsi (Eigenmann, 1907) – "tetra" [1, 3, 5]

Hyphessobrycon bifasciatus Ellis, 1911 – "tetra-amarelo" [2, 3, 4]

Hyphessobrycon eques (Steindachner, 1882) – "mato-grosso" [1, 3, 5]

Moenkhausia aff. *intermedia* Eigenmann, 1908 – "lambari-corintiano" [3]

Oligosarcus pintoi Campos, 1945 – "peixe-cachorro" [1, 3]

Piabina argentea Reinhardt, 1867 – "pequira" [1]

Acestrorhynchidae

Acestrorhynchus lacustris (Lütken, 1875) – "peixe-cachorro" [3]

Erythrinidae

Hoplerythrinus unitaeniatus (Agassiz, 1829) – "jeju" [2, 3, 4, 5]

Hoplias malabaricus (Bloch, 1794) – "traíra" [1, 2, 3, 4, 5]

SILURIFORMES

Callichthyidae

Callichthys callichthys (Linnaeus, 1758) – "caborja, tamboatá" [1]

Hoplosternum littorale (Hancock, 1828) – "caborja" [1, 2, 3, 4, 5]

Loricariidae

Loricariinae

* *Loricaria lentiginosa* Isbrücker, 1979 – "cascudo-avião"

Hypostominae

Hypostomus ancistroides (Ihering, 1911) – "cascudo" [1]

* *Hypostomus iheringi* (Regan, 1908) – "cascudo"

Hypostomus strigaticeps (Regan, 1908) – "cascudo" [1]

Pseudopimelodidae

* *Pseudopimelodus pulcher* (Boulenger, 1887) – "bagrinho"

Heptapteridae

* *Imparfinis borodini* Mees & Cala, 1989 – "bagrinho"

Rhamdia quelen (Quoy & Gaimard, 1824) – "jundiá" [1]

Pimelodidae

Iheringichthys labrosus (Lütken, 1874) – "mandi-beiçudo" [1]

Pimelodus cf. *fur* (Lütken, 1874) – "mandi" [1]

Pimelodus maculatus La Cepède, 1803 – "mandi-amarelo" [1]

Auchenipteridae

Trachelyopterus sp. – "cangati" [3]

GYMNOTIFORMES

Gymnotidae

Gymnotus carapo Linnaeus, 1758 – "tuvira" [1, 5]

Sternopygidae

Eigenmannia trilineata López & Castello, 1966 – "tuvira-amarela" [1]

CYPRINODONTIFORMES

Poeciliidae

Phalloceros harpagos Lucinda, 2008 – "guaru" [1, 5]

SYNBRANCHIFORMES

Synbranchidae

* *Synbranchus marmoratus* Bloch, 1785 – "muçum"

PERCIFORMES

Cichlidae

Geophagus brasiliensis (Quoy & Gaimard, 1824) – "cará" [1, 3, 5]

Acknowledgments: We are grateful to all the people who helped in different parts of this work, specially: Paulo Rubim, Geraldo Rubim, "Toninho", "Lei", Jeferson Lourenço, Ursulla Souza, Daniela Oliveira and Tatiana Moraes for their assistance in the field/laboratory work; Jaime de Freitas for the logistic support; Dr. Francisco Langeani Neto and Dr. Julio C. Garavello for fish identification; Guilherme J. Kawachi for English revision; IBAMA and COTEC for the license permit; CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior) for the mastership grants to the first author and the two anonymous referees for their suggestions.

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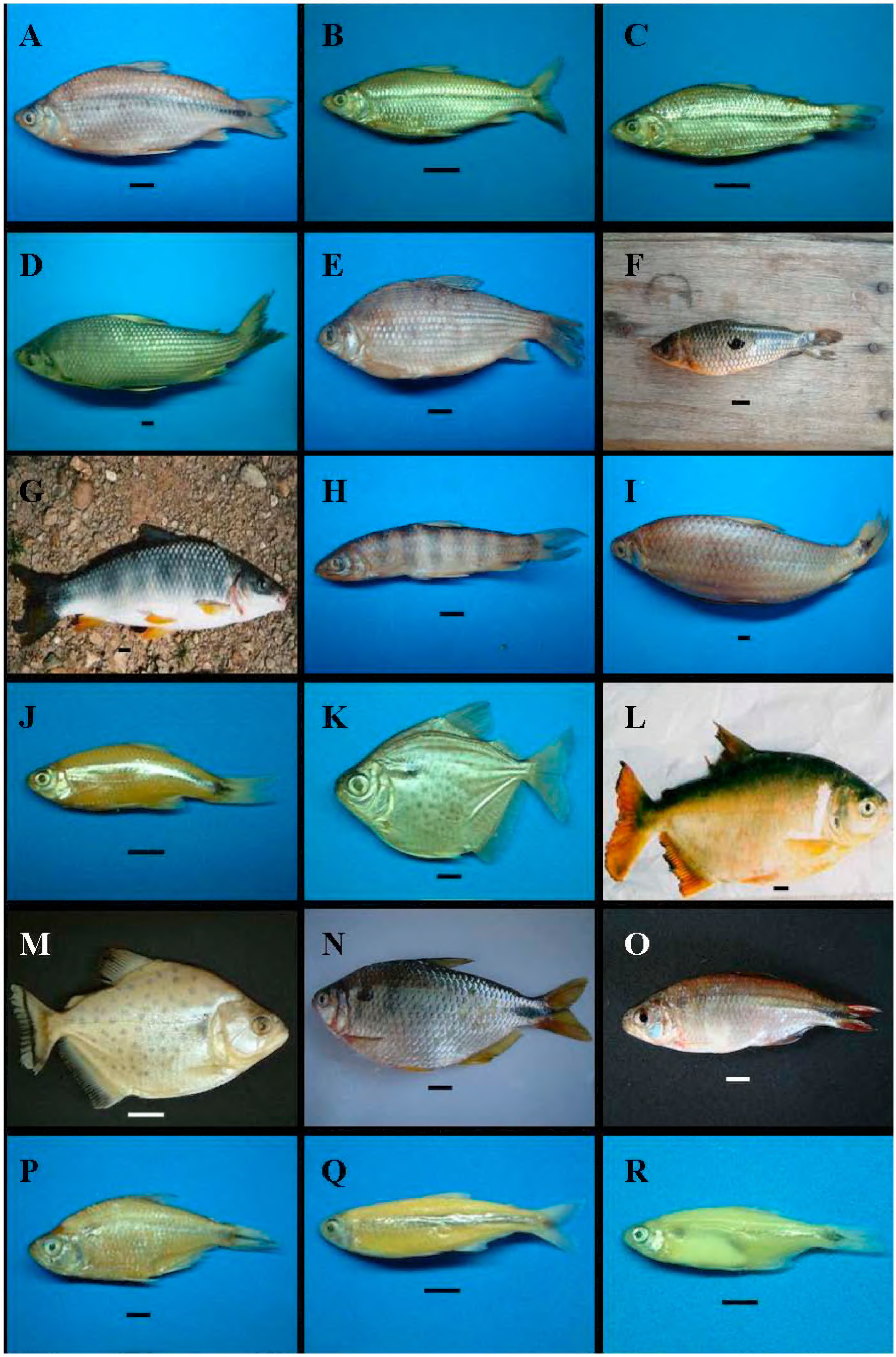
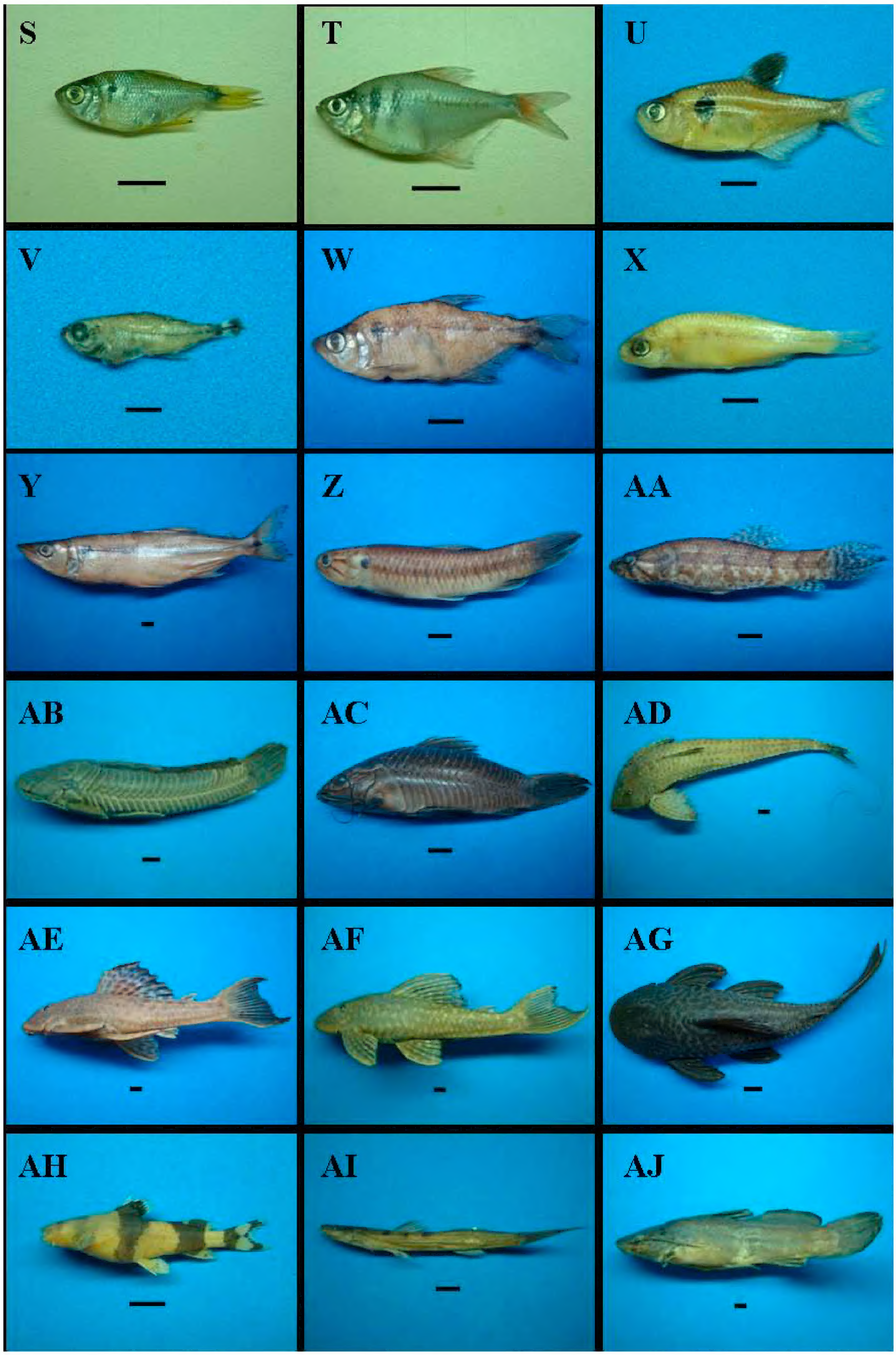
Received: July 2009
Revised: December 2009
Accepted: March 2010
Published online: April 2010
Editorial responsibility: Marcelo Loureiro

Appendix 1. Fish fauna from Mogi Guaçu reservoir and Ecological Station oxbow lakes (Campininha farm). The scale bars correspond to 1 cm and the asterisks indicate species with natural colors. A) *Cyphocharax modestus**, B) *Cyphocharax* cf. *nagelii*, C) *Steindachnerina insculpta*, D) *Prochilodus lineatus*, E) *Prochilodus vimboides**, F) *Leporinus lacustris**, G) *Leporinus obtusidens**, H) *Leporinus octofasciatus**, I) *Schizodon nasutus**, J) *Serrapinnus heterodon*, K) *Metynnis maculatus*, L) *Piaractus mesopotamicus**, M) *Serrasalmus maculatus*, N) *Astyanax altiparanae**, O) *Astyanax fasciatus**, P) *Astyanax schubarti*, Q) *Bryconamericus stramineus*, R) *Odontostilbe* sp.. Photos by C. S. Gonçalves.



Appendix 1. Fish fauna from Mogi Guaçu reservoir and Ecological Station oxbow lakes (Campininha farm). The scale bars correspond to 1 cm and the asterisks indicate species with natural colors. S) *Hyphessobrycon anisitsi**, T) *Hyphessobrycon bifasciatus*, U) *Hyphessobrycon eques*, V) *Moenkhausia* aff. *intermedia*, W) *Oligosarcus pintoi**, X) *Piabina argentea*, Y) *Acestrorhynchus lacustris**, Z) *Hoplerythrinus unitaeniatus**, AA) *Hoplias malabaricus**, AB) *Callichthys callichthys*, AC) *Hoplosternum littorale*, AD) *Loricaria lentiginosa*, AE) *Hypostomus ancistroides*, AF) *Hypostomus strigaticeps*, AG) *Hypostomus* cf. *iheringi*, AH) *Pseudopimelodus pulcher*, AI) *Imparfinis borodini*, AJ) *Rhamdia quelen*. Photos by C. S. Gonçalves.



Appendix 1. Fish fauna from Mogi Guaçu reservoir and Ecological Station oxbow lakes (Campininha farm). The scale bars correspond to 1 cm and the asterisks indicate species with natural colors. AK) *Iheringichthys labrosus*, AL) *Pimelodus* cf. *fur*, AM) *Pimelodus maculatus*, AN) *Trachelyopterus* sp.*, AO) *Gymnotus carapo*, AP) *Eigenmannia trilineata*, AQ) *Phalloceros harpagos* (male), AR) *Phalloceros harpagos* (female), AS) *Synbranchus marmoratus*, AT) *Geophagus brasiliensis**. Photos by C. S. Gonçalves.